the technique of depositing thin metallic films[13] on insect (e.g., wing-case of the beetle, *Plusiotis Resplendens*) tissue. This situation may mean that utilization of a dielectric tube waveguide (it may be necessary also to include consideration of fiber optics[14]) is simpler than a metallic one and may be simpler than a superconducting tubular one.

The proposed dielectric models already present formidable experimental and theoretical tasks for physicists and entomologists, because they require determination of pertinent physical, electrical, and optical (i.e., infrared) parameters of the salient micron size, living and dead, components and systems of the extraordinarily developed sensing organs of insects, which evidently function at the dominant infrared atmospheric windows. Nevertheless this task will have to be done if significant progress is to be made in matching electrical models to the insects' remarkable sensing organs and their extraordinary performances.

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Comment on "Recognizing Patterns in Photographs"

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Received 10 May 1965.

Judging by recent publications, many investigators in the field of pattern recognition seem to be unaware of the significant early contributions to this field, and of the substantial literature on statistical classification (dating back to the 1930's) which is directly applicable.

The paper by Rushforth[1] is a case in point. This paper does not make adequate reference to the prior art, and it is misleading with respect to the theoretical complexity and practical difficulty of problems in photographic pattern recognition.

First, Dr. Rushforth has attacked the wrong problem. In the solution of practical problems in photographic pattern recognition, the assumption that the random variables are independent is not valid, and does not yield acceptable results. Also, the author makes the assumption that the pattern to be recognized is known. It is fundamental to photographic pattern recognition that there is rarely an objective and explicity known representation of the reference pattern. Generally, the *ideal* characteristics of the reference pattern can only be determined approximately by experiments based on the analysis of a large sample of noisy patterns. Further, classification procedures for independent binary random variables are well established. Indeed, much more general classification procedures for correlated binary variables are available.[2–6]

Second, having attacked the problem, and having derived the correct classification function for independent binary variables with known probabilities [Eq. (4) of his paper] he misinterprets his result. He states that the general solution is a nonlinear function of the elements of the input pattern vector **y**. In fact, however, when Eq. (4) is rewritten in the form

$$\Lambda(\mathbf{y}) = \sum_i y_i \log\left(\frac{S_i}{1 - S_i}\right)\left(\frac{1 - R}{R}\right) + \log\frac{(1 - S_i)}{(1 - R)}$$

the classification function is seen to be an easily computed, linear function of the y_i's, and as such represents a matched filter. This solution is optimum for both high and low signal-to-noise ratios. Therefore, the special approximation that Rushforth derives for low signal-to-noise ratios is unnecessary, and only approximately optimum.

The paper also must be criticized on one other point. The technique of transforming a sampled gray-scale image into a binary form by simple thresholding is too primitive to be seriously considered for photographic pattern recognition. Often the pattern of interest will be of approximately the same brightness as its background, and a simple light/dark binary representation will not preserve the pattern contours, which are vital to successful recognition. There are other techniques, based on contour enhancement principles, for obtaining binary representations of gray-scale patterns which do show considerable promise.[5,7,8]

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Absorption of Radiation by Carbon Monoxide Gas According to the Exponential Wide-Band Model

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Received 26 April 1965.

Tien and Giedt[1] have recently presented experimental values of band absorption data for the 2143 cm^{-1} band of CO at a temperature of 1800°K. It is interesting to note that the measured total band values agree well with predictions using the simple exponential wide-band model[2] and spectroscopic data obtained at room temperature.[3]

In order to estimate total band absorption using the exponential wide-band model, it is necessary to have the integrated intensity, the rotational constant, the mean line-width-to-spacing ratio at a low temperature, and some knowledge of how absorption lines originating from upper vibrational states fall with respect to the lines originating from the ground state. All of this information is available[3] for CO except the last item. However, for the case of the simple CO molecule, new lines appear rather slowly as temperature is increased up to, say, 2000°K, so that a reasonable estimate can be made by assuming that the new lines do not coincide with the ones arising from transitions from the ground vibrational state. Thus the exponential wide-band model can be employed as indicated below.

The integrated intensity is found from Burch and Williams[3] to be 260 atm^{-1} cm^{-2}, i.e., $C_1 = 20.9$ cm^{-1}/(gm^{-2}). The rotational constant[4] $B = 1.931$ cm^{-1} indicates that the bandwidth parameter[2] C_3 is

$$C_3 \doteq 0.9\left[\Gamma^2\left(\frac{3}{4}\right)\left(\frac{2kTB}{hc}\right)^{1/2}\right], \tag{1}$$

$$C_3 = 38\,(T/300)^{1/2}\ \mathrm{cm}^{-1}.$$

The line-width parameter[2] is

$$C_2 = 4\, C_1^{1/2} C_3^{1/2} (\bar{\gamma}/d)^{1/2}. \tag{2}$$

From values[3] of line half-width, $\gamma = 0.08$ cm^{-1}, and spacing, $d = 3.8$ cm^{-1}, the resulting value of C_2 at $T_0 = 300$°K is 16.3 cm^{-1}/(g-m^{-2} atm)$^{1/2}$.

It remains to predict how C_2 varies with temperature. The parameter C_2 governs when the lines are not overlapped. Therefore, an effective line-width γ can be estimated by summing the contributions of nonoverlapped strong lines under the assumption that none of the lines originating from initial vibrational states above the ground vibrational state overlaps,

$$\left(\bar{\gamma} \sum_{v=0}^{\infty} S\right)^{1/2} \doteq \sum_{v=0}^{\infty} (\gamma S)^{1/2}, \tag{3}$$

where S is the intensity[5] of the band with initial state at vibrational quantum number v,

$$S = \left(\frac{8\pi^3 A_v \nu}{3hc}\right)\frac{\beta^2}{Q}\left(1 - e^{-hc\nu/kT}\right) e^{-hc\nu(v+1/2)/kT}, \tag{4}$$

Table I. Comparison of Total Band Absorption of the 2143 cm^{-1} Band of CO

				Experimental values	
Temp. (°K)	Mass path length (g/m^2)	Pressure (atm)	Present correlation for band absorption (cm^{-1})	Band absorption Burch and Williams[4] (cm^{-1})	Band absorption Tien and Giedt[1] (cm^{-1})
300	27.1	0.25	41.6	42	45
	54.2	0.50	83	85	89
	108.4	1.0	134	120	148
	217	2.0	184	160	184
	325	3.0	211	185	205
	54.2	0.25	59	60	66
	108.4	0.50	110	110	122
	217	1.0	161	150	169
	433	2.0	210	190	210
	650	3.0	237	210	226
1800	19	1.0	107		129
	28.5	1.5	160		172
	38.0	2.0	208		195
	47.5	2.5	246		247
	57.0	3.0	277		278
	38.0	1.0	154		159
	57.0	1.5	224		221
	76.1	2.0	278		268
	95.1	2.5	311		317
	114	3.0	340		347